SECTION 6
WEIGHT AND BALANCE

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1. Introduction

This section describes the procedure for establishing the basic empty weight and the moment of the aircraft. Loading procedure information is also provided.

NOTE

Aircraft must be operated in accordance with the limits concerning the maximum take-off weight and CG excursion as re- ported in Flight Manual Section 2.

Pilot is responsible for checking the weight and CG excursion are compliant with the related limits. C.G. excursion and Weight limits are reported in Section 2 – Limitations.

2. Weighing Procedures

2.1. PREPARATION

- Carry out weighing procedure inside closed hangar
- Remove from cabin any object unintentionally left
- Make sure Flight Manual and mandatory documents are on board
- Align nose wheel
- Drain fuel via the specific drain valve
- Oil and hydraulic fluid at the operating levels
- Move sliding seats in middle position
- Refuel/Defuel the aircraft with the unusable fuel
- Raise flaps to fully retracted position
- Place control surfaces in neutral position
- Place scales under each wheel

2.2. LEVELLING

- Level the aircraft (the reference for longitudinal levelling is made putting a spirit-level on the cabin floor as shown in the Aircraft Maintenance Manual).
- Adjust longitudinal attitude deflating nose tire

2.3. WEIGHING

- Record weight shown on each scale
- Repeat weighing procedure three times
- Calculate empty weight

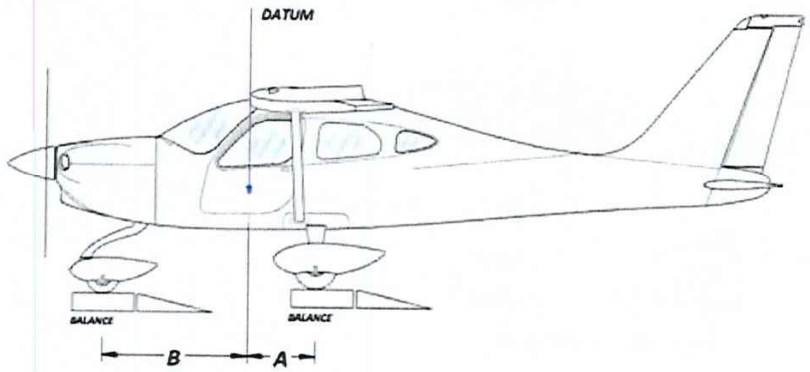
2.4. DETERMINATION OF C.G. LOCATION

- Drop a plumb bob tangent to the wing leading edge and trace a reference mark on the floor
- Repeat the operation for other wing
- Stretch a taught line between the two marks
- Measure the distance between the reference line and both main and nose wheel axis (A and B distances respectively)
- Using recorded data it is possible to determine the aircraft C.G. location and the aircraft moment (see following table)

2.5. Weighing Record

Model | *P2010TDI* S/N: 246 Weighing no. I Date: 20/09/2023

Datum: leading edge vertical



		kg or lbs
Nose wheel weight	W_1=	153
LH wheel weight	W_L=	340
RH wheel weight	W_R=	343
$W_2 = W_L + W_R$ =		683

	meters or feet
Plumb bob distance LH wheel	A_L = 0,678
Plumb bob distance RH wheel	A_R = 0,678
Average distance $\frac{(A_L + A_R)}{2}$	A = 0,678
Plumb bob distance from nose wheel	B = 1,420

Empty weight $W_e = W_1 + W_2$ = 842 [kg] or [lbs]

$$D = \frac{W_2 \cdot A - W_1 \cdot B}{We} = 0{,}2818 \text{ [m]} \longrightarrow D(\%MAC) = \frac{D - 0.013}{1.378} \cdot 100 = 19{,}5\%$$

$$D = \frac{W_2 \cdot A - W_1 \cdot B}{We} = \text{____} \text{ [ft]} \longrightarrow D(\%MAC) = \frac{D - 0.043}{4.520} \cdot 100 = \text{____}$$

Empty weight moment $M = D \cdot W_e$ = 237 [m · kg] or [ft · lbs]

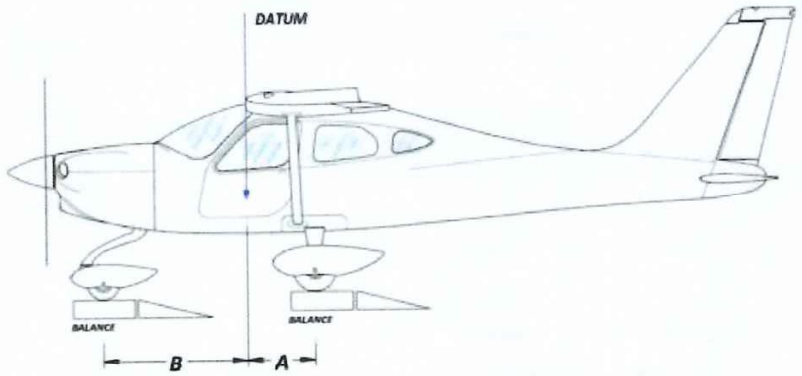
Maximum take-off weight	W_T = 1220	[kg] or [lbs]	Signature
Empty weight	W_e = 842	[kg] or [lbs]	
Max. useful load $W_T - W_e$	W_u = 378	[kg] or [lbs]	

Figure 6-1 - Aircraft Weighing Record

2.6. Weighing Record (II)

Model *P2010TDI* S/N:_____ Weighing no._____ Date:_____

Datum: leading edge vertical



	kg or lbs
Nose wheel weight	W_1=
LH wheel weight	W_L=
RH wheel weight	W_R=
$W_2 = W_L + W_R$ =	

	meters or feet
Plumb bob distance LH wheel	A_L =
Plumb bob distance RH wheel	A_R =
Average distance $\frac{(A_L + A_R)}{2}$	A =
Plumb bob distance from nose wheel	B =

Empty weight $W_e = W_1 + W_2$ = [kg] or [lbs]

$$D = \frac{W_2 \cdot A - W_1 \cdot B}{We} = ____ \quad [\text{m}] \longrightarrow D(\%MAC) = \frac{D - 0.013}{1.378} \cdot 100 = ____$$

$$D = \frac{W_2 \cdot A - W_1 \cdot B}{We} = ____ \quad [\text{ft}] \longrightarrow D(\%MAC) = \frac{D - 0.043}{4.520} \cdot 100 = ____$$

Empty weight moment $M = D \cdot W_e$ =	[m · kg] or [ft · lbs]

Maximum take-off weight	W_T =	[kg] or [lbs]	Signature
Empty weight	W_e =	[kg] or [lbs]	
Max. useful load W_T - W_e	W_u =	[kg] or [lbs]	_____

Figure 6-2 - Aircraft Weighing Record

3. Weight and Balance determination for flight

The pilot is responsible for ensuring the correct useful load loading.

In this subsection, the procedure to be used for the determination of aircraft weight and balance in flight is described. The weight and moment obtained must fall within the approved Weight-Moment Envelope (Figure 6-4). The procedure explained requires the use of:

- Aircraft Weighing Record (Figure 6-1/2)
- Weight and C.G. – Form (Table 6-1)
- Loading Diagram (Figure 6-3)
- Weight-Moment Envelope (Figure 6-4)

An example calculation is provided to help understand the method.

To determine weight and balance for flight, proceed as follows:

1. Read the most recent values of the Empty A/C weight and corresponding moment from the Aircraft Weighing Record (Figure 6-1/2) and write them in the Weight and C.G. – Form (Table 6-1)
2. Write the weight and moment of the pilot/co-pilot and occupant(s) in the Weight and C.G. – Form (Table 6-1). Calculate the moment as:

   Moment = weight X arm where the arm is read in Table 6-1

   Alternatively, the moment can be read from the Loading Diagram (Figure 6-3)
3. Sum the weights to obtain the zero fuel weight condition and write it in the Weight and C.G. – Form (Table 6-1). The zero fuel weight must not exceed its limit value provided in Section 2 and reported in Table 6-1.
4. Write weight and moment of the usable fuel in the Weight and C.G. – Form (Table 6-1). Determine the fuel moment using the procedure of step 2.
5. The total weight can be obtained summing zero fuel condition and usable fuel weights; the resulting moment is, instead, obtained summing all moments; report take-off condition (weight and moment) in the Weight and Balance C.G. – Form (Table 6-1)
6. To obtain the landing weight and moment, subtract from take-off condition values the weight and moment of the total fuel required. These values are reported in the Weight and Balance C.G. – Form (Table 6-1). Write the landing values Weight and Balance C.G. – Form (Table 6-1).
7. Locate on Weight-Moment Envelope (Figure 6-4) the points (weights and moment) corresponding to the take-off and landing conditions. If the points fall within the envelope, the loading condition meets the weight and balance requirements.

Table 6-1 - Weight and C.G. – Form

	W [kg] or (lb)	Arm [m] or (ft)	Moment (M) = W * Arm [kg*m] or (lb*ft)
Empty weight			
USEFUL LOAD			
Pilot		0.293 (0,96 ft)	
Co-Pilot		0.293 (0,96 ft)	
1st Passenger		1.070 (3,51 ft)	
2nd Passenger		1.070 (3,51 ft)	
Baggage		1.612 (5,29 ft)	
Usable fuel Fuel (liters) *ρ_{fuel} (0.8) [kg] Fuel (USg) *ρ_{fuel} (6.7) [lb]		0.625 (2,05 ft)	
Take-off condition **$W_{TO} = \Sigma W$**		**$M_{TO} = \Sigma M$**	
Fuel required Fuel (liters) *ρ_{fuel} (0.8) [kg] Fuel (USg) *ρ_{fuel} (6.7) [lb]		0.625 (2,05 ft)	
Landing condition **$W_L = W_{TO} - W_{fuel_req}$**		**$M_L = M_{TO} - M_{fuel_req}$**	

Table 6-2 - Weight and C.G. – Example

	W [kg] or (lb)	Arm [m] or (ft)	Moment (M) = W * Arm [kg*m] or (lb*ft)
Empty weight	765 (1687 lb)	0.245 (0,80 ft)	187.4 (1350 lb*ft)
USEFUL LOAD			
Pilot	80 (176 lb)	0.293 (0,96 ft)	23.4 (169 lb*ft)
Co-Pilot	80 (176 lb)	0.293 (0,96 ft)	23.4 (169 lb*ft)
1st Passenger	70 (154 lb)	1.070 (3,51 ft)	74.9 (541 lb*ft)
2nd Passenger	70 (154 lb)	1.070 (3,51 ft)	74.9 (541 lb*ft)
Baggage	20 (44 lb)	1.612 (5,29 ft)	32.2 (233 lb*ft)
Usable fuel Fuel (liters) $*\rho_{fuel}$ (0.8) [kg] Fuel (USg) $*\rho_{fuel}$ (6.7) [lb]	94 lt*0,8 = 75 kg 24,7 USg*6,7 = 165 lb	0.625 (2,05 ft)	46.9 (338 lb*ft)
Take-off condition **$W_{TO} = \sum W$**	**1160 (2557 lb)**	**$M_{TO} = \sum M$**	463.1 (3341 lb*ft)
Fuel required Fuel (liters) $*\rho_{fuel}$ (0.8) [kg] Fuel (USg) $*\rho_{fuel}$ (6.7) [lb]	40 lt*0,8 = 32 kg 10,5 USg*6,7 = 71 lb	0.625 (2,05 ft)	20.0 (146 lb*ft)
Landing condition **$W_L = W_{TO} - W_{fuel_req}$**	**1128 (2486 lb)**	**$M_L = M_{TO} - M_{fuel_req}$**	443.1 (3195 lb*ft)

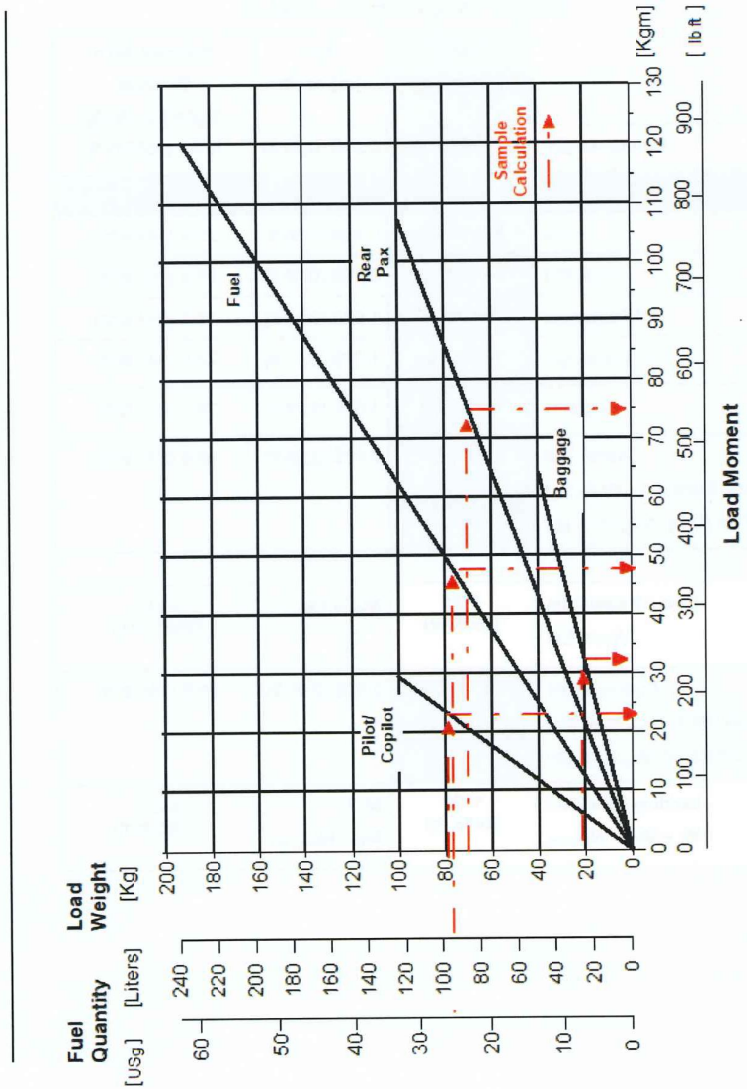


Figure 6-3 - Loading Diagram

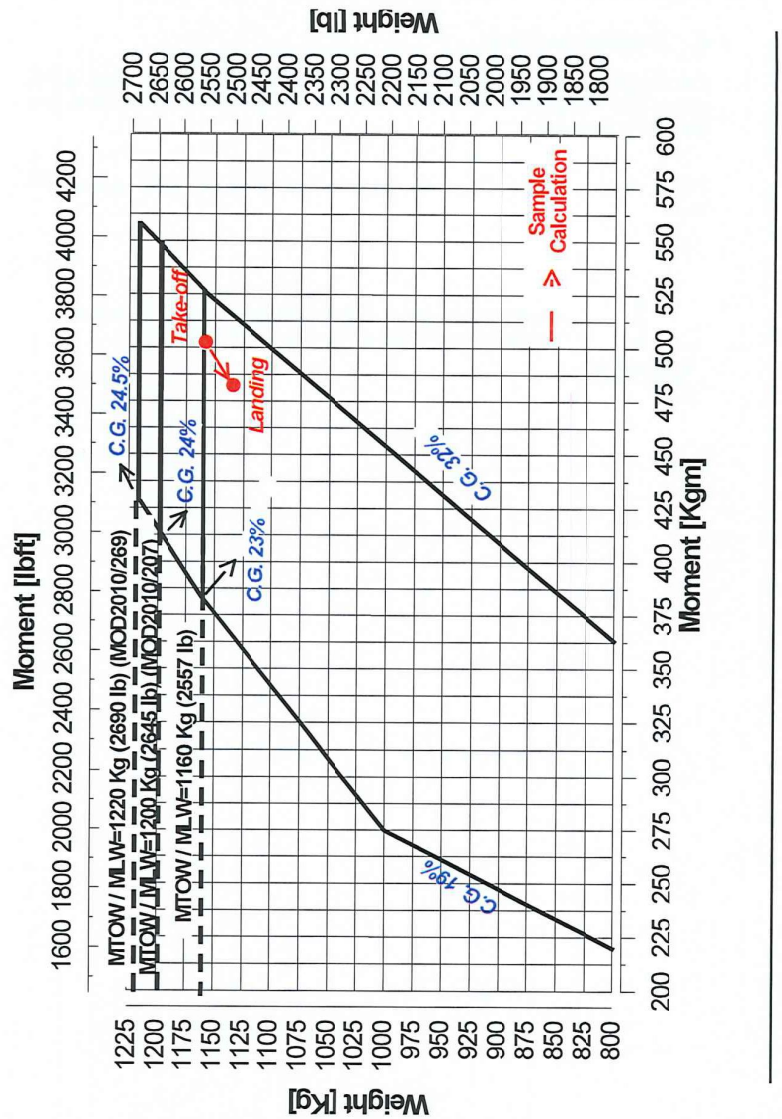


Figure 6-4 – Weight Moment Envelope

4. Baggage Loading

The baggage loading in the dedicated compartments must be carried out in accordance with diagram addressed and with C.G. excursion and weight limitations reported in Section 2.

Pilot is provided with tie-down nets and snap fasteners allowing for securing the loads.



CAUTION

Loading the baggage, make sure that you correctly stretched the net which must be secured to the hooking points.

5. Equipment List

This paragraph contains a list of equipment which may be installed on TECNAM P2010tdi. The items that have been installed on the aircraft at the time of its registration are marked with an "X" in the column "As deliv.". It is an operator's responsibility made on the airplane. New installations shall be marked in the column "Inst./Rem." With a "I" before the date, while removals shall be marked with a "R".

Id	Description	Model/PN	Weight (each)		Arm		As deliv.	Inst. / Rem. (I/R) & Date
			[kg]	[lbs]	[m]	[ft]		
ATA 22 – Auto Flight								
22-10-1	Servo Pitch GSA 80	011-00877-20	1.44	3.17	5.3	17.4	X	
22-10-2	Servo Roll GSA 80	011-00877-20	1.44	3.17	2.05	6.73	X	
22-10-3	A/P Control Panel	GMC 707	0.28	0.62	-0.69	-2.26	X	
ATA 23 – Communications								
23-10-1	COM 1 Antenna	Comant CI-121	0.23	0.5	1.88	6.16	X	
23-10-2	COM 2 Antenna	Comant CI-292-2	0.23	0.5	2.85	9.35	X	
23-10-3	Marker Beacon Antenna	010-10175-00	0.23	0.5	1.88	6.16	X	
23-15-1	Satellite Data-Link (Iridium)	Iridium GSR 56	1.11	2.45	0.69	2.26		
23-15-2	Iridium Antenna	AeroAntenna AT 1621-62	0.13	0.28	1.38	4.52		
		Comant CI-490-490	0.14	0.31	1.38	4.52		
23-50-1	Audio Panel	Garmin GMA 1360	0.60	1.32	-0.69	-2.26	X	
ATA 24 – Electrical Power								
24-30-1	Main Battery	Gil G247 @24V	19	41.88	4.8	15.78		
		TB-17 @24.6V	7.1	15.65			X	
24-30-2	FADEC backup battery	FIAMM FG20721 @12V	2.4	5.3	0.5	1.64	X	
24-30-3	FADEC backup battery	FIAMM FG20721 @12V	2.4	5.3	0.5	1.64	X	
24-30-4	Excitation battery	FIAMM FG20121 @12V	0.57	1.26	1.61	5.28	X	
24-30-5	Excitation battery	FIAMM FG20121 @12V	0.57	1.26	1.61	5.28	X	
ATA 25 - Equipment / Furnishing								
25-10-1	Pilot seat LH	210-10-5100-801	10	22	0.29	0.96	X	
25-10-2	Pilot seat RH	210-10-5200-801	10	22	0.29	0.96	X	
25-20-1	Passenger seat 1st LH	210-10-5300-801	9	20	1.070	3.51	X	
25-20-2	Passenger seat 1st RH	210-10-5400-801	9	20	1.070	3.51	X	
25-60-1	ELT System (Unit)	Kannad 406 AF	1.10	2.42	1.61	5.28		
		Kannad 406 Integra					X	
25-60-2	Fire extinguisher	A344T	1	2.2	-0.18	-0.59	X	
		A620T						
25-60-3	First aid kit	FIA270160	0.2	0.44	0.5	1.64	X	
ATA 27 – Flight Controls								
27-30-1	Servo pitch trim GSA 81	011-00878-20	1.03	2.27	5.3	17.4	X	
27-30-3	Flaps actuator	Sir AO-01/M 6814494	0.84	1.85	0.7	2.30	X	
27-30-4	Stall Warning	210-9-420-000	0.23	0.5	0	0	X	
ATA 28 – Fuel system								
28-40-1	Low Fuel q.ty sender – LH	Honeywell LLN8651721	0.020	0.044	0.5	1.64	X	
28-40-2	Low Fuel q.ty sender - RH	Honeywell LLN8651721	0.020	0.044	0.5	1.64	X	
28-40-3	Fuel q.ty sender – CIES – LH	CC284022-(1304)-(101)	0.29	0.64	0.5	1.64	X	

Id	Description	Model/PN	Weight (each)		Arm		As deliv.	Inst. / Rem. (I/R) & Date
			[kg]	[lbs]	[m]	[ft]		
28-40-4	Fuel q.ty sender – CIES – RH	CC284022-(1304)-(101)	0.29	0.64	0.5	1.64	X	
28-40-5	Fuel tank temp.probe LH	TSP-1MAN40305MZ	0.030	0.066	0.5	1.64	X	
28-40-6	Fuel tank temp.probe RH	TSP-1MAN40305MZ	0.030	0.066	0.5	1.64	X	
ATA 31 – Indicating / Reporting Systems								
31-20-1	Compass	C2400L4P or C2400L4P-SF	0.4	0.88	-0.69	-2.26	X	
31-40-1	COM/NAV/GPS Interface unit	Garmin GIA 64W	3.26	7.19	-0.69	-2.26	X	
31-60-1	MFD	GDU 1054	2.94	6.5	-0.69	-2.26		
		GDU 1050	2.94	6.5	-0.69	-2.26	X	
31-60-2	PFD	GDU 1050	2.94	6.5	-0.69	-2.26	X	
31-60-3	Standby Attitude and Air Data Computer	Mid-Continent MD302	0.73	1.61	-0.69	-2.26	X	
ATA 32 – Landing gear								
32-10-1	MLG Wheel Fairing	210-4-1020-001-L	1.5	3.3	Ref. to A distance in Weighing Record		X	
32-10-2	MLG Wheel Fairing	210-4-1020-001-R	1.5	3.3			X	
32-10-3	MLG Wheel	Goodyear 606C61B1	4.0	9			X	
32-10-4	MLG Wheel	Goodyear 606C61B1	4.0	9			X	
32-20-1	NLG Wheel Fairing	210-4-3001-401	1.2	2.6	Ref. to B distance in Weighing Record		X	
32-20-2	NLG Wheel	Goodyear 505C61-8	2.7	5			X	
ATA 33 – Lights								
33-40-1	Nav/Pos/Strobe Light– Ultragalactica Aveo	AVE-WPST (R/G)-54G	1	2.2	0.23	0.75		
	Nav/Pos/Strobe Light– Ultragalactica Aveo	Whelen OR6502RE Whelen OR6502GE	1	2.2	0.23	0.75	X	
33-40-2	Rudder Nav Light	AVE-POSW-(62 or 54)G or AVE-PSPSYW-T01	0.05	0.11	5.5	18.04	X	
33-40-3	Landing/Taxy Light – WHELEN Mod 7167400	01-0771674-00	2	4.4	-1.52	-4.99	X	
ATA 34 – Navigation Instruments								
34-10-2	ADC	Garmin GDC 72	0.73	1.6	-1.06	-3.47	X	
34-10-2	OAT Probe	Garmin GTP 59	0.6	0.8	0.94	3.08	X	
34-10-3	Pitot Probe	TECNAM 210-7-4550-401	0.35	0.77	0.5	1.64	X	
34-20-1	AHRS	Garmin GRS 79 unit	1.27	2.8	3.28	10.76	X	
34-20-2	Magnetometers	Garmin GMU 44B unit	0.16	0.35	3.28	10.76	X	
34-40-1	GPS 1 Antenna	Garmin GA 35 013-00235-00	0.21	0.47	0.65	2.13	X	
34-40-2	GPS 2 Antenna	Garmin GA 35 013-00235-00	0.21	0.47	0.65	2.13	X	

Id	Description	Model/PN	Weight (each)		Arm		As deliv.	Inst. / Rem. (I/R) & Date
			[kg]	[lbs]	[m]	[ft]		
34-40-3	Stormscope Processor	L-3 Avionics 805-11500-001	1.13	2.50	1.61	5.28		
34-40-4	Stormscope Antenna	L-3 Avionics NY-163 800-10930-001	0.38	0.84	5.5	18.04		
34-50-1	ADF System (Receiver Controller)	Becker Avionics RA 3502 0505.757-912	1	2.2	-0.69	-2.26		
		Becker Avionics RA 3502 (02) 0506.133-912						
34-50-2	ADF System (RMI Converter)	Becker Avionics AC 3504-01	0.5	1.10	-0.69	-2.26		
34-50-3	DME System (Antenna)	Bendix King KA61	0.41	0.9	-0.75	-2.46		
		Comant Industries C 105-16	0.41	0.9	-0.75	-2.46	X	
34-50-4	DME System (Unit)	Bendix King KN63 066-01070-0001	2	4.4	-0.69	-2.26	X	
34-50-5	Transponder	Garmin GTX 345 R	1.5	3.3	3.05	10.01	X	
34-50-6	Transponder (Antenna)	010-10160-00	0.41	0.9	-0.18	-0.59	X	
34-50-7	VOR/LOC/GS Antenna	Comant CI-158C	0.16	0.35	5.5	18.04	X	
34-50-8	ADF Antenna	AN 3500	1.7	3.75	1.45	4.75		
34-60-1	FMS	GCU 477	0.36	0.79	-0.69	-2.26	X	
ATA 35 – Oxygen System								
35-10-1	Mountain High	AL-180	1.42	3.13	0.450	1.47	X	
ATA 39 – Electrical/Electronic Panels and Multipurpose components								
39-40-1	Cockpit Cooling Blower & Fan	212-21-40-0730-000 RER 101-36/14 NHH	0.305	0.672	-0.69	-2.26	X	
39-40-2	Cockpit Cooling Blower & Fan	212-21-40-0730-000 RER 101-36/14 NHH	0.305	0.672	-0.69	-2.26		
ATA 61 – Propellers								
77-00-01	Propellers	MTV-6-R/190-69	14	30.86	-2.12	-6.9	X	
ATA 77 – Engine indicating								
77-00-01	EIS	Garmin GEA 71B	2.3	5.1	-0.80	-2.62	X	